



2006 SECTOR LOADING REPORT

PURPOSE

The City of San Jose (City) conducted the Sector Loading Project to update the average quantity (expressed in pounds per day) of specific pollutants discharged to the San Jose/Santa Clara Water Pollution Control Plant (Plant), broken down into the contribution from industrial, commercial, and residential sectors. The residential sector includes discharges from single family and multi-family dwellings. The industrial contribution comes from the Industrial Users permitted through the pretreatment program. The commercial sector is all other discharges of wastewater to the sanitary sewer system, including businesses such as retail stores, printing operations, automotive repair, and other services. For the purposes of the mercury part of this project, dental offices were considered a separate sector from the other commercial businesses. Updating the sector loading information for copper, nickel, and mercury is the primary focus of this planned sampling effort.

The City completed previous Sector Loading sampling programs between 7 and 12 years ago, and significant changes to the local population and mix of businesses over that period of time may have caused the available Sector Loading results to be less reliable. Updated pollutant loading and source identification information will be used for pollution prevention (P2) planning.

BACKGROUND

The Plant's 1993 NPDES Permit contained interim effluent limits for copper and nickel that were incorporated into the local limits setting process. The reevaluation of the local limits for the discharge of Industrial Waste at the time required sector loading information to calculate the industrial allocations for copper and nickel. An extensive sampling of sites representing commercial and residential discharge was performed during 1994 and 1995 to gather the necessary information. Samples were analyzed for metals, with the main focus on identifying the copper and nickel loading for the two sectors. Ten commercial and 10 residential sites were sampled over a year and a half period. Between 11 and 29 samples were collected from each site, with a total of 275 residential and 207 commercial samples collected overall.

The Plant's 1998 NPDES Permit contained Provision 5.2, a requirement to develop "an appropriate methodology to quantify flows and concentrations from various sectors including: residential, commercial, unpermitted industrial, and inflow & infiltration. This information will be used to evaluate and modify the pretreatment program and local limits as well as focused outreach and enforcement activities." To fulfill this permit requirement, *Headworks Loading Analysis Study* was submitted to the Regional Water Board in July 2000. The *Headworks*

Loading Analysis Study used the results from the 1994-1995 commercial and residential sampling program.

In 1999 a site representing dental discharge was sampled to determine the dental contribution of mercury. Ten 24-hour composite samples were collected from this dental site over a two-month period.

Total flow from residential and business sources is estimated and updated annually through a Plant flow projection model that uses data from the Association of Bay Area Governments and considers jobs and housing available in the area. The residential flow number was used to estimate residential loading. However, the businesses were not listed in a way that could easily separate the permitted industrial users from other commercial users, as our sector loading requires. The Environmental Enforcement Data Management System contains industrial flow rates for all permitted Industrial Users, and this information was used to determine the industrial flow. The commercial sector flow was estimated by subtracting out the industrial and residential flows from the total.

The following is a summary of the results from the 1994-1995 and 1999 sampling programs as reported in the July 2000 *Clean Bay Strategy Report*.

Sector Loading for Copper				
Sector	Flow (mgd)	Copper Conc. ($\mu\text{g/l}$)	Copper Loading (lbs/day)	Percentage of Plant Loading
Commercial	29.1	55	13.3	17
Industrial	11.5	--	8.6	11
Residential	76.7	46	29.4	37
	Total		51.3	64 %
Headworks	120	80.3	80.4	

Sector Loading for Nickel				
Sector	Flow (mgd)	Nickel Conc. ($\mu\text{g/l}$)	Nickel Loading (lbs/day)	Percentage of Plant Loading
Commercial	29.1	14	3.4	25
Industrial	11.5	--	4.8	35
Residential	76.7	8	5.1	37
	Total		13.3	97 %
Headworks	120	13.7	13.7	

Sector Loading for Mercury				
Sector	Flow (mgd)	Avg. Conc. ($\mu\text{g/l}$)	Mercury Loading (lbs./day)	Percentage of Plant Loading
Industrial	11.5	0.1	0.009	2.5
Commercial	29.1	0.29	0.069	21
Residential	76.7	0.12	0.077	21
Dental	0.47	45	0.18	49
		Total	0.335	92 %
Headworks	120	0.365	0.365	

As part of the 2005 Annual P2 Report submitted to the Regional Water Board, sector loading for copper, nickel, and mercury were estimated based on 2005 flows and the older concentration values. The sum of the 2005 estimated loadings from the industrial, commercial, and residential sectors did not correlate with the measured loading at Plant headworks. Based on described calculation method, the unaccounted for amounts of copper was 50% of the headworks data and unaccounted for nickel was 19% of the headworks data. Total estimated mercury loading was 36% over Plant headworks loading.

Compared to the results reported in 2000, the amount of unknown loading for copper, nickel, and mercury to the Plant has increased significantly. . To attempt to eliminate some of the uncertainty in source identification, monitoring in the sewer to update the sector loading estimates was undertaken in 2006.

SELECTION OF SAMPLE LOCATIONS

Ten commercial and ten residential sites were originally sampled to identify an average concentration for each sector in 1995. Each of the sites previously sampled was re-inspected to determine if conditions had changed that would prevent sample collection or make the sites less representative of the targeted sectors. Six of the original sampling sites, three residential and three commercial, were considered to still be viable sampling locations for the 2006 Sector Loading effort. To avoid skewing of the results, sites were chosen with different demographic compositions and in different cities throughout the Plant's Tributary Area. For instance, one of the residential sites collects wastewater from a newly developed area, while the other two are located in older developments. Similarly, one of the commercial sites is located in a business park and the other two are located in areas with automotive repair shops and light manufacturing businesses. The previously sampled dental site was used, along with a second newly identified site. The dental sites chosen have a large percentage of dental offices in a complex, discharging near the beginning of a sewer line. The following sample locations were selected for sampling:

Commercial sites

- 1C – Old Oakland Rd. and Commercial St., San Jose
- 2C – Cristich Lane, Campbell
- 3C – S. Milpitas Blvd. and Gibraltar Dr., Milpitas

Dental sites

- 1D – Torre Ave. and Pacifica Dr., Cupertino
- 2D – Willow St. and Westwood Dr., San Jose

Residential sites

- 1R – San Felipe Rd. and Yerba Buena Rd., San Jose
- 2R – Florence Dr., Cupertino
- 3R – Carnegie Dr., Milpitas

SAMPLE COLLECTION AND HANDLING

The target was to collect enough samples to account for weekly and daily variations of discharge type and quantity. A total of 20 samples at each site, approximately three samples at each site on each day of the week, were determined to adequately accomplish this. Composite samplers were placed into the identified manholes and used to collect 24-hour composite samples into a single container. Individual aliquots were collected every 15 minutes for a total of 96 aliquots collected over a 24-hour period. The hours of sample collection for the dental sites were modified to better match the working hours for those businesses, approximately 8 AM to 8 PM.

The aliquots were mixed to create one composite sample, transferred into bottles, preserved, and transported to the laboratory for analysis. The collected samples were analyzed for the identified pollutants of interest: copper, nickel, and mercury.

In order to account for possible contributions of mercury from the industrial sector, a single grab sample was collected from each permitted Industrial User (IU) discharging over 50,000 gallons per day and analyzed for mercury. This required the sampling of 26 IUs that cumulatively account for over 70% of the total industrial flow. Since the permitted IUs are routinely monitored for the other metals of interest and total industrial loading is routinely calculated, no additional samples were collected in this fashion for copper or nickel.

QUALITY ASSURANCE AND QUALITY CONTROL

Blanks were collected during the course of the sampling for quality assurance and quality control purposes. All the blanks were preserved in the same location, using the same preservatives, as the actual samples and analyzed by the laboratory. Equipment blanks were collected during the course of the sampling to determine if any contamination of the samples from the equipment used could occur. Equipment blanks were collected by sampling deionized water using a composite sampler equipped with the same type of tubing and collection bag that was used for the sector loading sampling. Travel blanks were also collected to determine if contaminants could be introduced into the samples during sample collection. Travel blanks were collected by filling sample bottles identical to those used for the sector loading sampling with deionized water at the Plant laboratory and then opening the bottles in the field at the sample sites during sample

collection. Three equipment blanks and three travel blanks were initially collected during the course of this project.

One of the equipment blanks contained an unexpectedly high mercury sample result. The sampler initially used to collect the equipment blank contained a distributor arm that moved during sample collection. The samplers used in the field did not contain a distributor arm. Some contamination could have been present on this distributor system causing the high mercury result. The original sampler was replaced by one of the samplers used in the field and three additional equipment blanks were collected. These blanks did not show elevated levels of any of the analyzed pollutants and, therefore, it's been concluded that mercury contamination of the actual samples was unlikely.

SECTOR FLOWS

For this analysis, sector flows were determined through the use of a combination of measured and estimated flow values. The residential flow estimate was taken from a flow model developed for the Plant Tributary Area. This flow model uses the total water sold from the local water purveyors, and allocates a percentage of the total for residential use. The industrial flow was calculated by taking the sum of average flows reported by all permitted IUs. Plant influent flow was calculated from the measured average daily influent flow readings from October 20, 2006 to November 20, 2006. The commercial flow was calculated by subtracting the residential and industrial flows from the average Plant influent flow. The dental flow estimate was based on flow monitoring during the 1999 dental sampling. The flows by sector used for the loading calculations were as follows:

Total Plant influent – 114.6 million gallons per day (mgd)

Residential – 74 mgd

Industrial – 8.3 mgd

Commercial – 32.3 mgd (31.8 non-dental)

Dental – 0.5 mgd.

SAMPLE RESULTS

The results of the sampling program conducted during 2006 were used to calculate the sector loading estimated concentrations. The sample results from each site were averaged into a single concentration representing each of the sectors. During review of the data one of the sample results from commercial site 1C was discarded as an outlier due to an extremely high result. The calculated average concentration results for each pollutant for each sector are shown in the Table below:

Summary of Sector Pollutant Levels ($\mu\text{g/l}$) from Sector Loading (2006)

Pollutant	Residential	Commercial	Dental	Industrial
Copper	61	162		
Nickel	5	23		
Mercury	0.20	0.17	63.7	0.01

The average concentration was used to calculate a loading using the 2006 estimated flow for each sector [average concentration (mg/l) x 8.34 x flow (mgd) = loading (lbs/day)]. The calculated loading for each sector is shown in the table below.

Summary of Sector Loading 2006 (lbs/day)

Pollutant	Residential	Commercial	Dental	Industrial
Copper	37.9	43.7		3.8
Nickel	3.1	6.2		1.8
Mercury	0.12	0.044	0.27	0.0005

A construction project at the Plant resulted in the temporary bypass of the final filtration process for a period of one month, from October 20, 2006 to November 20, 2006. During this bypass, samples were collected daily at the Plant influent and effluent. This resulted in the availability of more data than normal being collected over a short time coinciding with the start of the sector loading sampling. For the bypass period, headworks loadings for copper, nickel, and mercury were 103.5 lbs/day, 11.9 lbs/day, and 0.26 lbs/day, respectively and the average influent flow was 114.6 mgd. The flow and concentration data collected during this bypass period will be used as the basis for comparing the Sector Loading results to the Plant headworks loading. The loading values are listed in the following table.

Comparison of 2006 Sector Loading Results to Plant Headworks Loading

	Copper	Nickel	Mercury
Plant Headworks Loading (ppd)	103.5	11.9	0.26
Sector Loading (ppd)	85.4	11.1	0.44
Difference (%)	17	7	-67

Non-detected sample results

The laboratory evaluated the samples submitted during the first two weeks of the sampling program and determined that a higher dilution level was required for the sample analyses. All the sample results for the remainder of the program were reported at a higher detection limit than those for the first two weeks.

Every effort was made to interpret the data for non-detect sample results in a manner that most reasonably approximated the unknown levels of pollutants. The analytical results fell into one of three basic groups:

Group 1-- the lab detected a sample result using the lower detection limit, but found all non-detect values with the higher detection limit.

Group 2 -- the lab found no detected values using both the higher and lower detection limits.

Group 3-- the lab found a mixture of detected and non-detected values using both the higher and lower detection limits.

These sample results were used in the calculations in the following ways:

Group 1 -- samples used the actual sample value whenever available, regardless of the detection limit used. Sample results that were undetected at the higher detection limit were assessed a concentration equal to the average detected concentration.

Group 2 -- samples were assessed a concentration equal to one half the lower detection limit.

Group 3 -- non-detect samples were assessed a concentration equal to the higher detection limit.

FINDINGS AND RECOMMENDATIONS

The comparison of Sector Loading sample results to Plant headworks loading indicates the sampling program reduced the unknown quantities of copper and nickel. The sample results accounted for 83% of the copper and 93% of the nickel entering the Plant headworks. The mercury results continue to overestimate the loading expected at headworks increasing from an overestimation of 36% to 67% in the current study. However, the study reinforced the contribution from dental offices as the largest source of mercury.

Copper

The copper results indicate that the residential copper loading has increased by over 30%, and by nearly 200% for the commercial sector since the last sector loading study. One of the three commercial sample sites was mainly responsible for this increase, and three of the results were quite high. The highest result was eliminated from the data set prior to the calculations as an outlier.

If all three of the high values were removed from consideration, the copper loading increase for the commercial sector would still show roughly a 90% increase from the last study. While the magnitude of the increase in commercial sector loading is arguable, it is clear from the sampling data that additional investigation into the commercial sector copper sources is warranted.

The City is evaluating the following steps for investigating the commercial copper sources.

- An evaluation of the businesses upstream of this sample site to identify potential sources of copper
- Further investigation of the sample sites and commercial businesses for data correlation and comparison.
- Review of sewer mains and business sectors for additional sample sites with a similar business mix.
- Additional sampling to verify copper loading for the commercial sector.
- Comparison of data from different sites to determine if the high results are unique to this location.

Additional efforts to address the copper discharge in this location will be identified and implemented over the near future, based upon the results of the investigation.

The largest source of residential copper is believed to be due to corrosion, so opportunities to continue the outreach to control corrosion from the installation of copper piping may be further investigated. The Plant continues to be in compliance with copper discharge limits.

Nickel

The overall nickel results are similar to the past sample results, showing a small decrease in the residential and industrial nickel loading and an increase in the commercial nickel loading. Many of the nickel results were below detection limits resulting in some uncertainty in the total loads. The agreement between sector loading results and headworks loading indicates no unknown sources of nickel are discharging in the Plant's Tributary Area. The Plant is currently in compliance with their nickel discharge limits. No further efforts to control nickel are indicated by the sample results.

Mercury

The commercial and industrial mercury contributions are less than the previous study results, but the residential and dental results are higher. The sector loading overestimates the total mercury significantly compared to the measured loading at headworks. A large variation in the results from the dental sites was observed. One possible explanation for this variation is the presence of particulate mercury in dental amalgam discharged from the dental offices. A large amount of mercury present in amalgam particulates makes the collection and laboratory analysis of homogeneous samples difficult. The amalgam may also settle and accumulate in the sewer system, never reaching Plant headworks to be measured. The large percentage of mercury from the dental sector indicates the City should continue the development of a program targeting reductions in the discharge of dental amalgam.